Final Public for ESA-099-3

Company	United States Steel Corporation	**ESA Dates**	6/9/08 – 6/11/08
Plant	Fairfield Tubular Operations	**ESA Type**	Pumping Systems
Product	Seamless Steel Pipe	**ESA Specialist**	Steve Bolles

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

The U. S. Steel – Fairfield Tubular Operations seamless pipe mill produces tubular products ranging from 4.5 to 9.875 inches outside diameter. These products are manufactured for the oil tubular goods markets. The facility produces 640,000 tons of seamless tubular products annually.

Objective of ESA:

The goal of the ESA was to apply the PSAT program, associated screening, measurement, and analysis methodologies to several pumping systems in order to:

a) Train plant personnel on the use of the DOE tools and methods
b) Identify savings potential in the selected systems and perform a preliminary evaluation of the cost-effectiveness of implementing projects to reduce energy consumption.

Focus of Assessment:

Before starting the assessment, the pump specialist and facility staff reviewed facility pump systems to determine which pumps would be the best candidates for improvement. Pump systems evaluated included:

- Quench Hot Well Pumps
- Quench Cold Well Pumps
- Hot Water Tank Pumps
- Non-Contact Supply Pumps
- Contact Supply Pumps
- Scale Pump System

The pumps were selected based on size and opportunity for improvement.

Approach for ESA:

<u>General</u>

Ken Mills and David Crump coordinated the Pump ESA effort. ESA participants included Harry Suggs, Larry Prestago, and Leigh McDanal.

<u>Field Measurements</u>

Quench Hot Well Pumps

Three 200 hp double suction pumps are available to transfer water from the hot well to the top of the cooling towers. Normally the facility operates two of these pumps in parallel. Pump TDH was determined from discharge pressure readings using portable pressure instrumentation and suction tank level. Power measurements were taken at the MCC using a Fluke 43B power meter. Since we were not able to get a flow reading using portable instrumentation on any of the pumps, flow was estimated using the pump curve. The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Quench Cold Well Pumps

The facility has three 500 hp pumps to transfer water from the cold well to the quench process. Typically two pumps are operated for two separate quench zones. To evaluate each pump system, total head was determined from suction tank level and discharge pressure readings using portable pressure instrumentation. Amperage measurements were taken at the MCC using existing analog meters (4160 V) and flow was estimated using the existing pump curves. The data was entered into the PSAT software tool to estimate existing pump efficiency and evaluate potential system improvements.

Hot Water Tank Pumps

The facility has two 200 hp hot water tank pumps that transfers flow from a hot water collection tank to the cooling towers. During our site visit we took measurements on Pump #2 which was operating. Pump TDH was determined from suction and discharge pressure readings using portable pressure instrumentation. Power measurements were taken at the MCC using a power quality analyzer. Flow could not be measured directly, but was being measured on the flow pumped from the cooling tower sump which was 5500 gpm (no pump curve was available to confirm this value for the HW pumps). The data was entered into the PSAT software tool to determine existing pump efficiency and evaluate potential system improvements.

Non Contact Pumps

Seven 200 hp non-contact pumps are available to transfer flow from the cooling tower sump to the plant process systems. Normal operation is to operate three pumps in parallel. During our site visit we took measurements on one of the pumps in operation. Pump TDH was determined from suction tank level and a discharge pressure reading using portable pressure instrumentation. Power measurements were taken at the MCC using a power quality analyzer and flow for one pump was estimated from the system flow meter. The data was entered into the PSAT software tool to determine existing system efficiency and evaluate potential system improvements.

Contact Pumps

Seven 200 hp contact pumps are available to transfer flow from the cooling tower sump to the plant process systems. Normal operation is to operate three pumps in parallel. Pump TDH was determined from suction tank level and a discharge pressure reading using portable pressure instrumentation. Power measurements were taken at the MCC using a power quality analyzer and flow was determined from the system flow meter.

Scale Pit Pumps

The facility uses seven 200 hp scale pit pumps to distribute water from the scale pit sump through the water treatment filters. During our site visit two pumps were in operation. We took pressure measurements on the common discharge header and at the filter to determine pump TDH and power measurements were taken at the MCC using a power quality analyzer. Flow was determined from the system flow meter. The data was entered into the PSAT software tool to determine existing system efficiency and evaluate potential system improvements.

General Observations of Potential Opportunities:

<u>2007 Plant Annual Operating Energy Data</u>

	kWhs	**MMBtu**		
Electricity	123,000,000			
Natural Gas		2,061,540		
Total	**123,000,000**	**2,061,540**		

Specific Opportunities Observed

Quench Hot Well Pumps

The three 200 hp quench hot well pumps transfer water from a below grade collection tank and pump the flow through individual in-line filters that are no longer in use (although pressure drop across the filter was 1 to 2 psi). The flow is then directed to individual “Lakos” scale separators. These devices remove solids through centrifugal force before flow is directed to the top of the cooling towers. Periodically a flush valve is opened (8 second every 8 minutes) to remove the accumulated scale. The pressure measurements taken at each pump discharge varied significantly. The off-line pump revealed a minimal pressure of 10 psi while the discharge pressure of the two on-line pumps was 30 and 48 psi. Since the “lift” to deliver the water to the top of the towers was approximately 25’ (11 psi), it appears that there is a significant pressure drop across the Lakos separators.

We recommend contacting the manufacturer to determine the design pressure drop across the Lakos unit and determine if system head was excessive. If this is typical, the facility may want to bypass the Lakos unit and consider refurbishing the existing strainers where pressure drop would typically be in the 2 to 4 psi range. Reducing system head to a more reasonable level (38’ used for our analysis), and adjusting pump capacity by trimming impellers to match system requirements could provide an annual savings of approximately $148,000 ($74,000 each pump). Based on an estimated cost of $20,000 for system improvements, this project is expected to pay for itself in two months.

To confirm the preliminary data collected, we recommend performing individual pump down tests during the next plant shutdown to determine existing pump efficiency, and installing pressure taps on either side of the Lakos system to verify pressure drop estimates (to verify that pressure drop is not from some other restriction in the piping system).

Quench Cold Well Pumps

Three 500 hp pumps are used transfer water from the cold well to the quench process. One pump provides a constant flow to part of the quench process at a pressure of 50 to 55 psi. However, the second pump varies flow depending on the size of the pipe being quenched. Facility staff indicated that 60% of the time 40-45 psi is required and 40% of the time 80 to 85 psi is needed for the process. To vary system pressure, a dump valve is used for Pump #1 to re-circulate flow through the process. Based on discussions with the operator, there is no dump valve on Pump #3, however it appears that a throttled discharge valve is used to reduce flow (we did not identify this during our site visit) since the pressure is reduced substantially at the process (55 psi).

Based on pressure measurements and the original pump curve, we estimated flow to be 5,800 gpm for Pump #3 and 6,450 gpm for Pump #1. A summary of measurements and how the pumps are matched to system requirements are shown below.

	Pressure at Pump	Flow from Pump Curve	Pressure at Process	System Flow Req.
Pump #1 (closed dump valve)	93 psi	6,450 gpm	80 psi	6,450 gpm
Pump #1 (open dump valve)	54 psi (est)	8,000 (est.)	40-45 psi	4,000 gpm (est)
Pump #3	104 psi	5,800	55 psi	5,800 gpm

We recommend installing a VFD on Pump #1 to eliminate the need for dumping flow 60% of the time (estimated to be 4000 gpm). Not only will this reduce Pump #1 energy use, but will also reduce the pumping required for the hot well pumps since the dumped flow was routed directly to the hot well instead of being re-circulated to the cold well. This improvement is expected to result in $98,000 in annual savings. However, it will require investing in a medium voltage variable speed drive (estimated project cost of $150,000) providing a simple payback in 1.5 years. Although we did not evaluate the potential savings of reducing the head for Pump #3, we recommend investigating this system in more detail.

Hot Water Tank Pumps

The facility typically uses one of two 200 hp hot water tank pumps to transfers flow from a hot water collection tank to the cooling towers. To regulate suction tank level a discharge control valve is used to increase or decrease pump flow as required. During our site visit the valve was 40% closed and the pressure at the pump discharge was 41 psi (95’ head). We estimated the elevation difference between the suction tank level and the top of the cooling tower was approximately 20’. Since there are no other noticeable restrictions in the piping system, the majority of head loss appears to be from the control valve (approximately 70’). Based on this, we recommend either removing the control valve and installing a variable speed drive to adjust pump flow to maintain tank level, or downsizing the pumps by trimming the impeller and using the control valve in a “mostly open” position to adjust flow. Using this data with the PSAT tool, approximately $70,000 in annual energy savings could be realized. Whether a variable speed drive (estimated cost of $50,000) or an impeller trim (estimated cost of $10,000), simple payback is expected to be less than one year.

Non Contact Pumps

During our site visit, three 200 hp non-contact pumps were used to transfer flow from the cooling tower sump to the plant process systems. Based on data collected for one of these pumps (individual flow estimated from total flow), pump efficiency was determined to be 63% using the PSAT tool. If this is typical for the other system pumps, we recommend upgrading the pumps to more efficient units. Potential savings to high efficiency units would be approximately $60,000 annually. Based on a $90,000 project cost (30,000 for three pumps), simple payback would be 1.5 years.

Contact Pumps

The contact pump system is similar to the non-contact system with seven pumps available but three pumps are typically operated in parallel. During our review, we observed that when the line was shutdown system discharge flow was reduced from 7200 gpm @ 92 psi to 3000 gpm @ 122 psi. According to facility staff, this occurs approximately 30% of the time. Although the most cost effective system would incorporate variable speed drives that would automatically adjust pump speed to maintain discharge pressure, a simple solution to immediately reduce system energy use would be to shutdown one pump during this period. Based on a measured 154 kW for one pump, taking one pump off-line 30% of the time would provide annual savings of $29,000.

Scale Pit Pumps

The facility uses seven 200 hp scale pit pumps to distribute water from the scale pit sump through the water treatment filters. Based on discussion with facility staff, typical operation is to operate two pumps in parallel using a discharge control valve (~30% open) to maintain sump level. Our first thought was to operate one pump with the control valve mostly open, however, we found that this would push the operating point too far out on the pump curve and could result in cavitation or motor overload. It appears that the most cost effective solution would be to install two variable speed drives on the existing pumps. This will eliminate the need for the control valve and will match system requirements more efficiently. Using the PSAT valve tool, estimated savings for eliminating the control valve and installing two variable speed drives would be approximately $85,000. Based on an estimated project cost of $60,000 for two variable speed drives, simple payback would be less than one year.

Other Opportunities

In addition to the recommendations discussed above we recommend the following initiatives:

- Purchase test equipment (flow meter, kW meter and pressure transducer) and perform pump efficiency tests as part of routine maintenance.
- Install pressure taps with isolation valves on the suction and discharge of pump systems to measure pressure.
- Install permanent power monitors for all medium voltage pump systems.

Management Support and Comments:

The staff was very supportive of the effort and provided the assistance needed to conduct the assessment.

DOE Contact at Plant/Company:

Facility contact: David Crump   Corporate contact: Ken Mills